# Vesta Mineralogy: VIR maps Vesta's surface

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## Abstract

The Dawn mission will have completed Survey orbit around 4 Vesta by the end of August 2011. We present a preliminary analysis of data acquired by the Visual and InfraRed Spectrometer (VIR) to map Vesta mineralogy. Thermal properties and mineralogical data are combined to provide constraints on Vesta's formation and thermal evolution, delivery of exogenic materials, space weathering processes, and origin of the howardite, eucrite, and diogenite (HED) meteorites.

## 1. Introduction

In July of 2011, the Dawn spacecraft will rendezvous with 4 Vesta. Dawn will spend a year in Vesta orbit studying its surface and gravity field to determine its geologic history and to establish its relationship with a particular suite of meteorites, the HEDs. VIR is the Dawn's instrument devoted to the study of the mineralogical composition of Vesta's surface as well as its thermo-physical properties [1].

The instrument performs imaging spectroscopy in the range from the near UV (0.25 μm) through the near IR (5 μm) and has moderate to high spectral resolution and imaging capabilities [2].

The asteroid surface mineralogical composition can be identified thanks to visual and infrared spectral features. Moreover the instrument can discriminate compositional classes through the identification of these features on the surface, thanks to the imaging capability.

## 2. Measurements Objectives

One of the main goals of Dawn is to determine the mineral composition of the surface and to place it in geologic context. Several diagnostic absorption bands for key minerals occur in the visible and near-infrared regions and can be identified with spectroscopic measurements. Some key scientific questions addressed by VIR include:

- Confirm or not the link between Vesta and the HED meteorites;
- Obtain the first in-depth view of a planetary interior through the spectral imaging of Vesta's wide and deep impact basin;
- Reveal the nature of Vesta's ancient magma ocean or volcanic emplacement history;
- Determine the mineralogy of a protoplanet that has remained at its formation location; and
- Study the nature of the regolith, including thermophysical properties, space weathering, and exotic materials.

Maps of the current surface mineralogy lead to the understanding of the surface evolution and determination of the processes affecting it. VIS and Near IR spectroscopy contribute to asteroid studies by delineating absorption features which are not resolved with broad band filters and by refining the measurement of differences in spectral shape such as band depth and width.

The VIR excellent image capability gives important information on surface geology through the production of mineralogical maps, to be associated

with the morphological information of the surface given by imaging generated both by VIR and by the camera. VIR produce maps at different resolutions, depending on the height of the orbits, therefore global mineralogical characteristics of the surface will be complemented by local detailed information gathered on lower orbits.

## 3. Conclusion

Our present understanding of Vesta is based on telescopic remote sensing and the analysis of the HED meteorites, which are thought to be representative of Vesta as a whole [3].

The new VIR data on the materials exposed on the asteroid's surface provide new insights into the processes that produced the solar system's largest differentiated asteroid.

## Acknowledgements

Dawn's VIR was provided by ASI, the Italian Space Agency and is managed by INAF, Italy's National Institute for Astrophysics, in collaboration with Selex Galileo, where it was built.

This work is supported by ASI grant

## References

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